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ABSTRACT

This paper describes a project designed to: (1) develop a model for determining occupational activity components to be used in any vocational-technical program, (2) produce a list of occupational activity components (tasks) for the occupational roles identified, (3) determine scores, ranks and percentages for each component from each occupational group per selected industry, (4) determine the percentage of time devoted to each component, (5) statistically determine the degree of likeness between occupational groups, and (6) prepare a report of the findings for use in curriculum development for a 2-year Industrial Projection Technology program at the community college level. The thesis advanced during the project was that there is a common core of skills among successful industrial production technologists and that this core should serve as the basis for any proposed program of studies for Industrial Production Technology. The instrument used in accumulating information for the project included a list of 100 components to denote the job requirements for a given industrial job description administered to different employee groups participating in the project. Results in graphs and tables are presented with implications for curriculum development. (MF)

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THE IDENTIFICATION AND COMPARISON OF THE TASKS FOR THE OCCUPATIONAL ROLE OF INDUSTRIAL PRODUCTION TECHNOLOGIST

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Presented
by
John G. Nee, Project Developer
Division of Mathematical Sciences and Technologies
Lincoln Land Community College
at
The Annual Meeting of the
American Educational Research Association
New Orleans

February 1973

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THE IDENTIFICATION AND COMPARISON OF THE TASKS FOR THE OCCUPATIONAL ROLE OF INDUSTRIAL PRODUCTION TECHNOLOGIST

The Problem

The central problem of the project was the determination of the core of skills required by those individuals successfully employed as industrial production technologists. The basic thesis advanced during the project was that there is a common core of skills among those individuals assuming this occupational role. This core of skills must serve as the basis for valid content selection, curriculum development, and evaluation for any proposed program of studies for Industrial Production Technology. The project involved the following major premises:

1. The determination of activity component items or tasks for use in the development of an instrument which should properly measure supervisors and technicians judgements;
2. The administration of the instrument to selected representatives from an identified target population of industrial production supervisors and technicians;
3. The assignment of scores, ranks, and frequencies to each activity component item by samples of employed workers to denote a judgement as to the amount of knowledge and/or experience required. The groups of employed workers were drawn from various industries in Springfield, Illinois;
4. The statistical analysis of the collected data to determine the presence or lack of agreement among the occupational levels and the selected industries; and
5. The formulation of implications for curriculum planning and technician training.

The Definitions

It seems advisable to define and clarify the meaning of the following terms or phrases as they are used in the project report.

1. Activity components are those constituent elements comprising the tasks which a worker uses in performing normal functions relative to his particular occupation.
2. The curriculum is broadly defined as those activities and experiences utilized by the school to achieve the goals of education.
3. Curriculum development is the process of determining content and planning, organizing, implementing, and evaluating educational change.
4. Industrial Production Technology is defined as the occupational area which identifies certain industrial production problems, solves them by research, production planning, quality control, time and motion study, plant planning, and human engineering.

Objectives of the Project

The project was translated into an appropriate set of objectives. The project objectives and approximate completion times were:

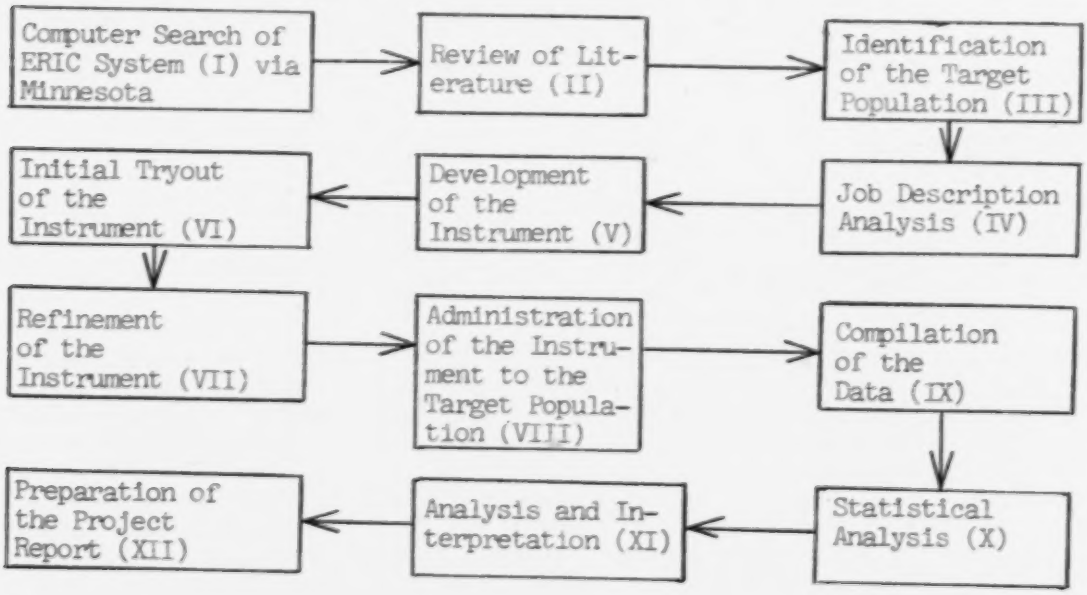
1. To develop a general model for use in determining and utilizing occupational activity component items. This model should be able to be used for developing any Vocational-Technical program. (1.0 week).
2. To produce a valid instrument consisting of a non-exhaustive list of occupational activity component items or tasks for the occupational role previously defined. See Appendix B. (1.0 week).
3. To determine average scores, ranks, and percentages for each component item from each occupational group per selected industry. (1.0 week).
4. To determine the percentage of time devoted to each component item by each occupational group per selected industry. (0.5 week).
5. To statistically determine the degree of likeness between occupational groups per selected industry. (2.0 weeks).
6. To organize and prepare a complete report and summary of the findings for use in curriculum development for a two-year Industrial Production Technology program at the community college level. (3.0 weeks).

The project began on June 12, 1972 and terminated on August 12, 1972.

Description of Activities

The developmental plan for completing the project involved the activities described graphically in Figure 1.

(Project START: 6-12-72)


Computer Search of ERIC System (I) via Minnesota
Review of Literature (II)
Identification of the Target Population (III)
Job Description Analysis (IV)
Development of the Instrument (V)
Initial Tryout of the Instrument (VI)
Refinement of the Instrument (VII)
Administration of the Instrument to the Target Population (VIII)
Compilation of the Data (IX)
Statistical Analysis (X)
Analysis and Interpretation (XI)
Preparation of the Project Report (XII)

(Project FINISH: 8-12-72)

FIGURE 1
ACTIVITY SEQUENCE
FOR COMPLETION OF THE PROJECT

Computer Search of ERIC System (1)

In an attempt to obtain a complete listing of sources relevant to the problem, the project developer completed a computer search of the Minnesota Research Coordinating Unit for Vocational Education Library. The Minnesota RCU receives materials from the ERIC Clearinghouse for Vocational and Technical Education, The Ohio State University, and as a result has maintained a relatively complete collection of hardcopy, microfilm, and microfiche available for use by researchers.

Key words were supplied to the Minnesota RCU staff and they responded with the computer printout. This printout served as the basis for the project bibliography used during the review of literature.

The Related Literature and the Rationale for the Project (II)

In recent years, many approaches have been used to obtain information which may serve as a basis for occupational preparation. This section of the report presents statements based on the related literature and proceeds through to the evolvement of the theoretical construct for the project.

Smith and Pucel [8, pp. 2-3] indicate that one of the most widely used and accepted techniques for identifying and organizing the instructional goals for occupational training programs is the trade and job analysis (Fryklund [3]). The basic rationale of the trade and job analysis technique is to identify and then to teach to students the manipulative skills (doing operations) and knowledges (technical information) possessed by on-the-job workers. Operationally, this means that subject matter experts observe the performances of on-the-job workers and record the type and frequency of each psychomotor behavior. Cognitive knowledges possessed by each workman are then inferred from specific psychomotor tasks which were previously identified.

The structure of the criterion behaviors of the workers is obtained by developing a rank order listing of the psychomotor behaviors based on the frequency and complexity of each. The most frequent, less complex operations and knowledges are taught to students first and are followed by less frequent, more complex operations, until all of the on-the-job psychomotor behaviors have been mastered.

Task analysis techniques were discussed by Smith and Pucel [8, pp. 3-4] as a second method used in curriculum development. Recently, psychologists working with military training research, have studied and written extensively (Ammerman and Melching, [1]; Smith, [10]; Melching, [6]) about using task analysis to identify, analyze and classify instructional objectives. Because of the wide range of jobs and the large number of servicemen who must receive specific occupational training, the military services have spent considerable time and effort in developing task analysis as the single, most generalizable technique for identifying the criterion performance standards for military courses of instruction. While there are similarities between trade and job analysis and task analysis, task analysis strongly reflects the military services' increasing concern with the problems of (a) identifying the major criterion behaviors for each job, (b) developing the optimal sequence of instructional elements and (c) writing standards of performance to evaluate each objective.

Task analysis is predicated on the principle (Gagne, [4]) that any human task can be analyzed into relatively distinct component behaviors which

are meditational, instructional links that are prerequisite to the mastery of some identifiable terminal task.

Smith and Pucel [8, p. 10] indicate that these methodologies represent only two of many approaches to content determination. The trade and job analysis technique and the task analysis method are two of the more practical and popular techniques presently in use. It is likely that some combination of the techniques discussed is more reasonable than any one in isolation or that new techniques and methodologies must yet be developed.

Moss and Smith [9, pp. 1-5] indicate that the first step in the curriculum development process should be the specification of the role for which training is to be provided. The second step in the curriculum development process is to identify the tasks in the specified role.

Crawford [2] indicated that job analysis is the first step in a systems engineering process for training. This job or occupational role must be analyzed in appropriate detail before any other steps can be taken. The steps following job analysis are totally dependent on the accuracy and thoroughness of the analysis.

Powers [7] stated that we are to use the following steps to identify knowledge and skill requirements:

Step 1: A preliminary task inventory should be developed by utilizing expert opinion, job standards, doctrine, and existing job descriptions. As a starting point, an inventory should be devised using written sources of information and then be submitted to technical experts for informal comment.

Step 2: The preliminary task inventory will be sent to the field for comment by job incumbents and other experts. The principal of this step is to gather recommendations as to the addition or deletion of knowledges and skills to the preliminary task inventory.

Step 3: The final inventory will be developed by assessing the field comments on the preliminary inventory. A major judgement here will be whether the field comments reflect local job variation rather than basic knowledge and skill components that should be taught at a school.

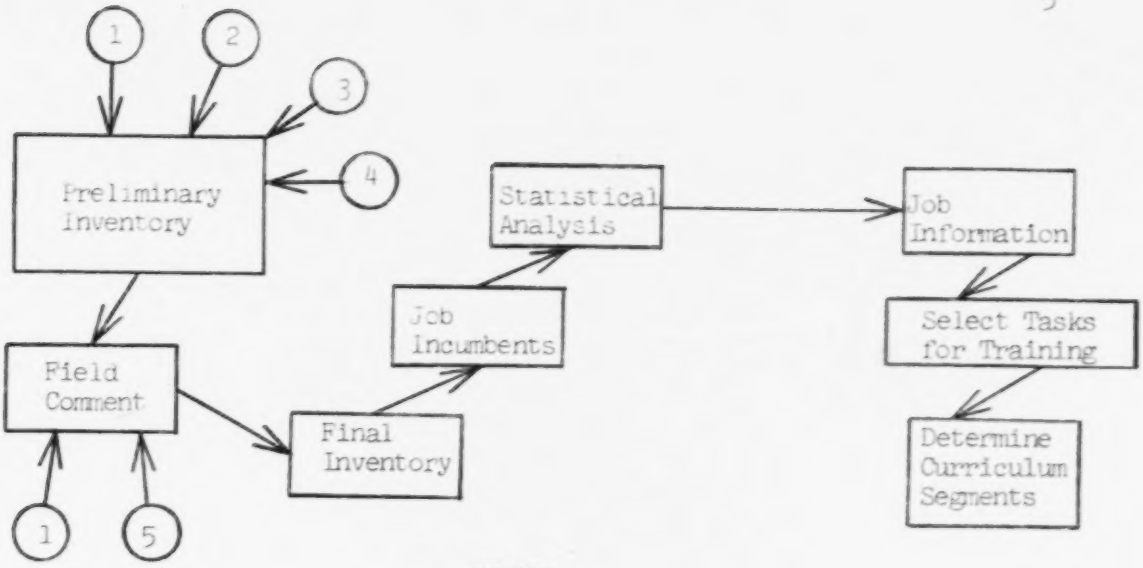
Step 4: The final inventory will be submitted to job incumbents for comment. The basic information sought will consist of which knowledges and skills on the list are being performed, how much time is required to complete them, and how important they are to mission accomplishment.

Step 5: When completed and returned to the research staff, the data will be subjected to statistical analysis. The analysis will develop the job information from which the training tasks and instructional objectives can be determined [7, pp. 23-25].

Figure 2 illustrates the sequence of the above five steps.

The analysis system illustrated by Figure 2 should be multidimensional, for example, dimensions dealing with: (1) job entry vs career development tasks; (2) specific vs related job tasks and; (3) predominately cognitive vs psychomotor vs affective tasks.

Moss and Smith [9, pp. 4-5] indicate criteria for selecting the tasks to be taught. The following are some of the criteria: (1) the practical limit on the number of tasks to be taught is a function of the total time available and the time it takes to teach each selected task to a reasonable level of "functional utility"; (2) the tasks must be selected in such a manner as to be representative of the total task domain; (3) tasks should be selected



INPUTS

1 - Expert Opinion
2 - Job Standards
3 - Doctrine
4 - Job Descriptions
5 - Job Incumbents

FIGURE 2
ANALYSIS SYSTEM

that permit the greatest generalizability; (4) tasks which have the greatest frequency of use in the job (or time spent on them) might be selected; (5) tasks which have emergency value or grave consequences for poor performance should be selected; (6) tasks that are more "economical" to learn in the formal training program than on-the-job should be selected; and (7) tasks whose performance might reasonably be considered a prerequisite to the training program should not be selected.

Rational vs empirical approaches to job/task descriptions were discussed by Kopstein [5]. He was of the opinion that it is difficult to find a pure example of either approach. Kopstein [5] clarified the contrast between the purely rational and purely empirical approach. The purely rational approach will develop an exhaustive set of the behavioral capabilities requisite for a certain job or task constellation (group) [5, p.3]. This is shown in Figure 3. The illustration shows the capabilities as discrete elements (ε) in the total set, that is, some hypothetical job or task. The elements are subscribed merely for identification within the total set. If some order was defined, the dashed line in Figure 3 should be regarded as an abscissa.

Kopstein [5] indicated that the purely empirical approach will develop a set of behavioral knowledge and skill components together with associated frequencies of occurence (probabilities), as illustrated in Figure 4.

In addition to observing the probabilities of occurrence of components, one might wish to examine optimal task allocations to job-levels so as to minimize training time and cost. Figure 5 illustrates the range of probabilities for each level within an occupation.

FIGURE 3
SCHEMATIC PRESENTATION
OF BEHAVIORAL CAPABILITIES
WITHIN SOME JOB/TASK SET

FIGURE 4
SCHEMATIC REPRESENTATION OF
FREQUENCY OF OCCURRENCE OF
ACTIVITY COMPONENTS

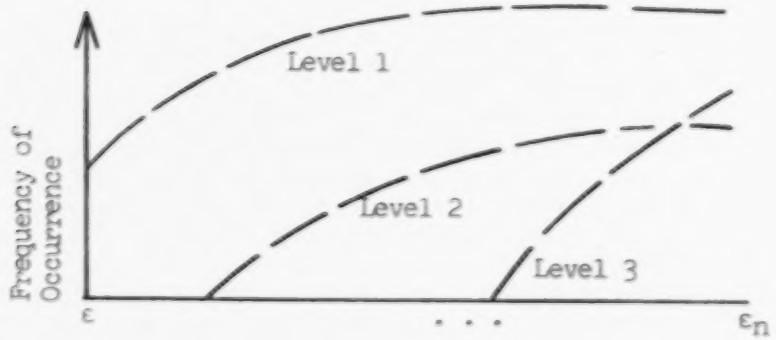


FIGURE 5
SEGMENTING TASKS
BY JOB LEVELS

From the literature cited the following statements were formulated for purpose of setting the basis of the theoretical framework for the project:

1. Occupations may be classified, and studied, by a variety of techniques.
2. Job requirement classification has called upon approaches that are varied and many.
3. Occupational studies have utilized data collection by check lists, as well as through the methodology of factor analysis and component frequency identification.

Identification of the Target Population (III)

For this project the subjects were selected by the project developer with the advice of industrial supervisory personnel. Representative subjects were selected from the following industries:

1. Sangamo Electric Company
   P. O. Box 3347 - Eleventh and Converse
   Springfield, Illinois 62708
   (John A. Patton, Manager Industrial Relations)
   (217)544-6411
2. Bunn-O-Matic
   1400 Stevenson Drive
   Springfield, Illinois 62703
   (Gene Rescho, Assistant Chief Engineer)
   (217)529-6601
3. Allis-Chalmers Manufacturing Company
   Box 2988 - 3000 South Sixth Street
   Springfield, Illinois 62710
   (Charles Shepard, Manager Personnel Services)
   (217)544-6431
4. Hobbs Division
   Stewart-Warner Corporation
   Yale Boulevard and Ash Street
   Springfield, Illinois 62705
   (Vaughn Ripley, Manager Industrial Relations)
   (217)525-0330

Job Description Analysis (IV)

The initial and most critical step in the development of any technical training program is to specify and describe what a person must know and be able to do in the job situations for which he is being trained. The more precisely these performance specifications can be defined, the easier it is to develop efficient programs of instruction.

The job descriptions reviewed and analyzed during this phase of the project include:

1. Chief Manufacturing Engineer
2. Chief Industrial Engineer
3. Chief Process Engineer
4. Assistant Chief Manufacturing Engineer
5. Manufacturing Engineer (Senior)
6. Process Engineer (Chemical)

7. Manufacturing Engineer (Electronics)
8. Industrial Engineer (Senior)
9. Process Engineer (Metallurgist)
10. Process Engineer (Plastics)
11. Manufacturing Engineer (Factory Liaison)
12. Industrial Engineer
13. Process Engineer (Electronics)
14. Manufacturing Engineer (Product)
15. Industrial Engineer (Junior)
16. Manager, Production and Inventory Control
17. Assistant Manager, Production and Inventory Control
18. Product Leader
19. Section Leader
20. Expediter
21. Manager, Quality Assurance and Inspection
22. Chief Quality Control Engineer
23. Quality Control Engineer
24. Dependability Statistician
25. Quality Control Systems Analyst
26. Quality Assurance Engineer
27. Preproduction Planning Analyst
28. Production Control Analyst
29. Junior Industrial Engineer
30. Supervisor of Quality Assurance
31. Inventory Control Clerk

Development of the Instrument (V)

The instrument used during this project consisted of a list of 100 components, together with a system of assigning scores, ranks, and frequencies to each component to denote the job requirements for a given industrial job description. The actual selection of the 100 components included in the study was made by the project developer. In attempting to control bias, no attempt was made to classify components according to subject matter area. The 100 components were grouped in fives by the use of a table of random numbers.

Initial Tryout of the Instrument (VI)

Before the instrument was used in the field, it was administered on a trial basis and was deemed to be satisfactory for use during the project. The project developer utilized upper management personnel in the review and initial tryout of the instrument.

Refinement of the Instrument (VII)

During the initial tryout of the instrument a number of suggestions were made in respect to the addition or deletion of components. Generally, there were no major revisions made as a result of the initial tryout of the instrument.

Administration of the Instrument to the Target Population (VIII)

A total of four groups of unequal sizes were selected to participate in the project. The type and size of each industry dictated the number of individuals available during the project. A total of thirty individuals from the target population were selected with the assistance of management personnel from each industry.

Compilation of the Data (IX)

The project developer gathered the necessary raw data by use of the questionnaire schedule exhibited in Appendix B. Each employee in the selected groups was asked to score the 100 activity components by use of the following key:

1. My job requires no knowledge or experience with this activity.
2. My job requires some knowledge or experience with this activity.
3. My job requires a reasonable amount of knowledge or experience with this activity.
4. My job requires a thorough knowledge and considerable experience with this activity.
5. My job requires a complete knowledge or experience with this activity so that it is essential to the job.

The responses indicated by the 30 employees to each of the 100 components provided 3,000 cells in a total response matrix. These raw data were used to determine: (1) average ($\bar{\bar{X}}$) component score per group; (2) average ($\bar{X}$) subject scores; and (3) average ($\bar{X}$) group scores.

Table 1 indicates the average item scores for Group I. The same kinds of data were found for Groups II, III and IV. Figure 6 graphically depicts these same average item scores per group with appropriate interpretations. Only the first ten components are illustrated in this report.

Tables 2, 3, 4 and 5 indicate the average ($\bar{X}$) subject scores and average ($\bar{\bar{X}}$) group scores.

Each employee was also asked to respond by indicating the approximate number of times the activity component was performed during the past month and the past year. Table 6 indicates these responses and the number (n) of subjects from Group I experiencing the activity. The same kinds of data were found for Groups II, III and IV. Interpretations accompany each table.

In addition to component scoring and frequency approximation, each employee was asked to rank order in groups of five each activity component. The employees were to rank each component in terms of priority of need for the technician to have knowledge of a given component in order to solve technical problems and to progress in his work. A one (1) indicated the greatest need and a five (5) indicated the least need.

Figure 6 illustrates the percentages of first ranks for the first five components by Group I. The number (n) of employees selecting a component item as most important in terms of priority of need to progress in his work is indicated together with the appropriate percentage of the total group number. Interpretations accompany each figure.

TABLE 1

AVERAGE ITEM SCORES FOR GROUP I*

Item — $\bar{X}$	Item — $\bar{X}$	Item — $\bar{X}$	Item — $\bar{X}$
1 — 2.09	26 — 2.45	51 — 1.09	76 — 2.45
2 — 2.54	27 — 1.45	52 — 4.00	77 — 1.72
3 — 2.54	28 — 4.63	53 — 2.54	78 — 2.09
4 — 1.36	29 — 1.81	54 — 1.27	79 — 2.00
5 — 2.18	30 — 1.63	55 — 4.81	80 — 1.90
6 — 4.09	31 — 1.36	56 — 2.54	81 — 2.81
7 — 2.18	32 — 1.90	57 — 2.63	82 — 2.90
8 — 2.72	33 — 3.27	58 — 2.81	83 — 2.54
9 — 2.09	34 — 2.36	59 — 2.00	84 — 1.36
10 — 1.09	35 — 2.63	60 — 2.72	85 — 2.09
11 — 2.27	36 — 2.72	61 — 2.63	86 — 1.63
12 — 3.18	37 — 1.63	62 — 3.36	87 — 1.54
13 — 2.54	38 — 2.63	63 — 2.36	88 — 3.09
14 — 2.45	39 — 1.54	64 — 2.18	89 — 2.63
15 — 3.27	40 — 2.00	65 — 3.45	90 — 2.27
16 — 3.18	41 — 1.45	66 — 2.81	91 — 2.72
17 — 1.72	42 — 2.09	67 — 3.81	92 — 1.72
18 — 2.27	43 — 1.81	68 — 3.81	93 — 1.36
19 — 2.18	44 — 1.54	69 — 2.09	94 — 1.54
20 — 2.90	45 — 2.54	70 — 2.00	95 — 1.72
21 — 2.27	46 — 2.45	71 — 2.00	96 — 2.45
22 — 2.63	47 — 2.90	72 — 1.72	97 — 2.00
23 — 2.18	48 — 2.45	73 — 2.87	98 — 1.09
24 — 2.00	49 — 2.09	74 — 2.81	99 — 1.36
25 — 3.27	50 — 2.81	75 — 2.45	100 — 2.00

*GROUP N=11

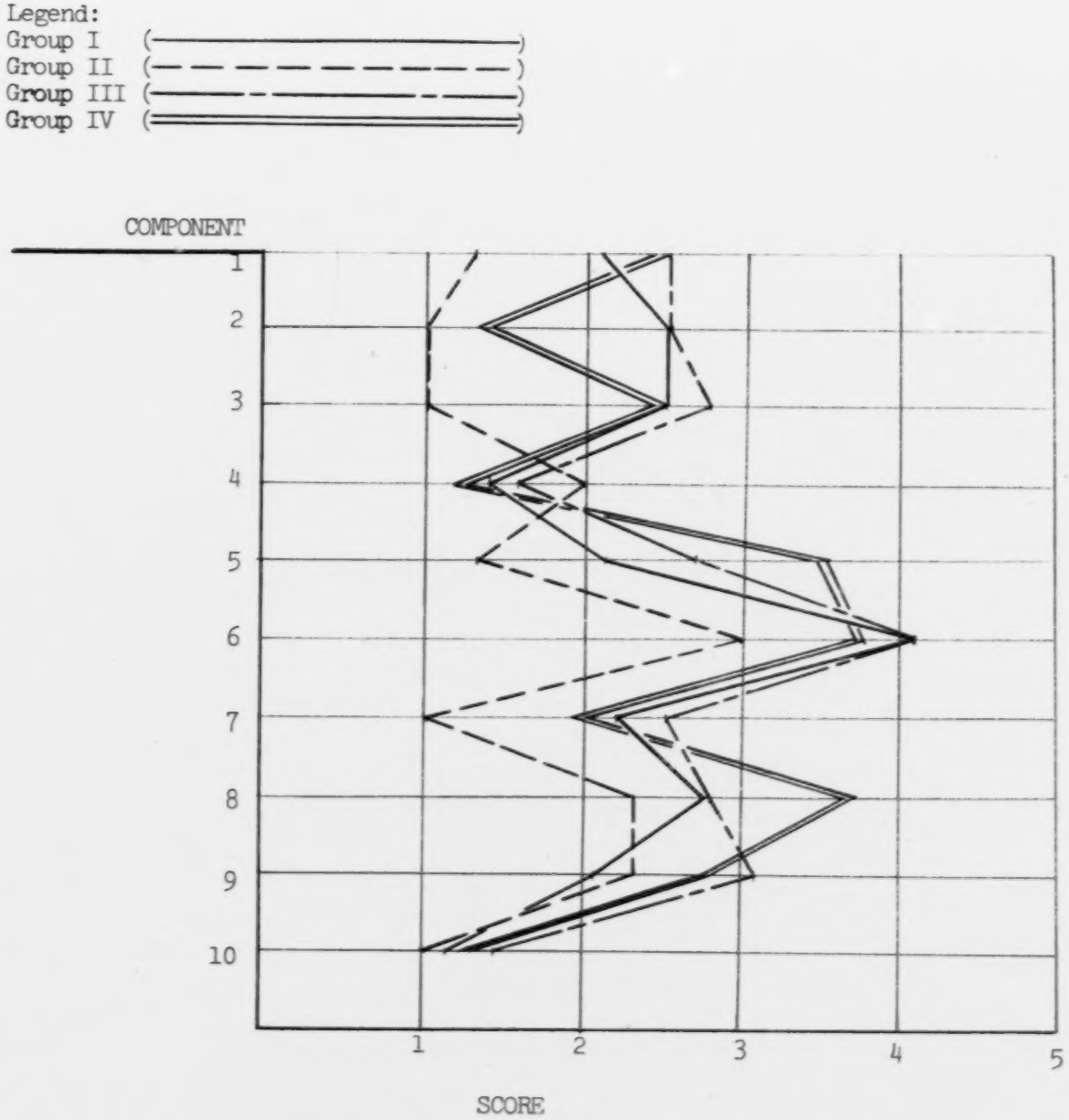


FIGURE 6
GRAPHICAL PRESENTATION
OF AVERAGE COMPONENT SCORES PER GROUP

Interpretation -- High need components were: (5) develop management control systems; (6) perform liaison between engineering and production; and (8) prepare layouts of machinery or equipment.

Low need components were: (4) perform plant location surveys; and (10) develop wage and salary administration programs.

TABLE 2
AVERAGE SUBJECT* SCORES FOR GROUP I

Subject	$\bar{X}$	$\bar{\bar{X}}$ (Group)
S1	1.90	
S2	1.87	
S3	3.14	
S4	3.22	
S5	3.16	2.34
S6	2.89	
S7	1.57	
S8	1.66	
S9	2.32	
S10	1.97	
S11	2.14	

*Item N=100

TABLE 3
AVERAGE SUBJECT* SCORES FOR GROUP II

Subject	$\bar{X}$	$\bar{\bar{X}}$ (Group)
S12	2.18	
S13	1.35	1.75
S14	1.74	

*Item N=100

TABLE 4
AVERAGE SUBJECT* SCORES FOR GROUP III

Subject	$\bar{X}$	$\bar{\bar{X}}$ (Group)
S15	2.20	
S16	2.68	
S17	2.40	
S18	1.41	
S19	2.85	
S20	2.40	2.40
S21	1.84	
S22	2.19	
S23	2.86	
S24	2.41	
S25	2.89	
S26	2.68	

*Item N=100

TABLE 5
AVERAGE SUBJECT* SCORES FOR GROUP IV

Subject	$\bar{X}$	$\bar{\bar{X}}$ (Group)
S27	2.54	
S28	2.64	2.36
S29	1.94	
S30	2.33	

*Item N=100

TABLE 6
ITEM FREQUENCY OF OCCURRENCE FOR GROUP I

Item	Number Times Per Last Month	n*	$\bar{X}$	Number Times Per Year	n*	$\bar{X}$
1	6	3	2.00	310	3	103.33
2	8	4	2.00	83	4	20.75
3	52	7	7.42	700	7	100.00
4	2	1	2.00	12	2	6.00
5	7	2	3.50	56	3	18.66
6	134	9	14.88	2393	9	265.88
7	112	4	28.00	1640	4	410.00
8	15	3	5.00	283	5	56.60
9	7	3	2.33	89	5	17.80
10	1	1	1.00	5	2	2.50
11	55	4	13.75	2482	5	496.40
12	25	5	5.00	349	9	38.77
13	35	5	7.00	196	6	32.60
14	9	5	1.80	211	7	30.14
15	31	5	6.20	643	7	91.85
16	15	4	3.75	364	8	45.50
17	0	0	0.00	3	2	1.50
18	4	3	1.33	116	5	23.20
19	8	3	2.66	102	6	17.00
20	5	4	1.25	45	6	7.50
21	2	1	2.00	9	2	4.50
22	248	5	49.60	3501	6	583.50
23	7	4	1.75	104	5	20.80
24	54	3	18.00	675	3	225.00
25	73	8	9.12	855	10	85.50
26	13	5	2.60	290	6	48.33
27	51	2	25.50	410	2	205.00
28	337	10	33.70	4285	11	389.54
29	9	3	3.00	100	3	33.33
30	1	1	1.00	5	2	2.50
31	1	1	1.00	7	2	3.50
32	1802	3	600.66	21792	4	5448.00
33	46	6	7.66	782	10	78.20
34	8	2	4.00	102	4	25.50
35	154	3	51.33	2271	6	378.50
36	72	6	12.00	1404	6	234.00
37	0	0	0.00	2	1	2.00
38	61	4	15.25	712	7	101.71
39	1	1	1.00	25	1	25.00
40	5	2	2.50	63	4	15.75
41	1	1	1.00	30	1	30.00
42	3	3	1.00	34	5	6.80
43	26	3	8.66	710	3	236.66

*Group n varies per item depending on job.

TABLE 6 (Cont'd.)

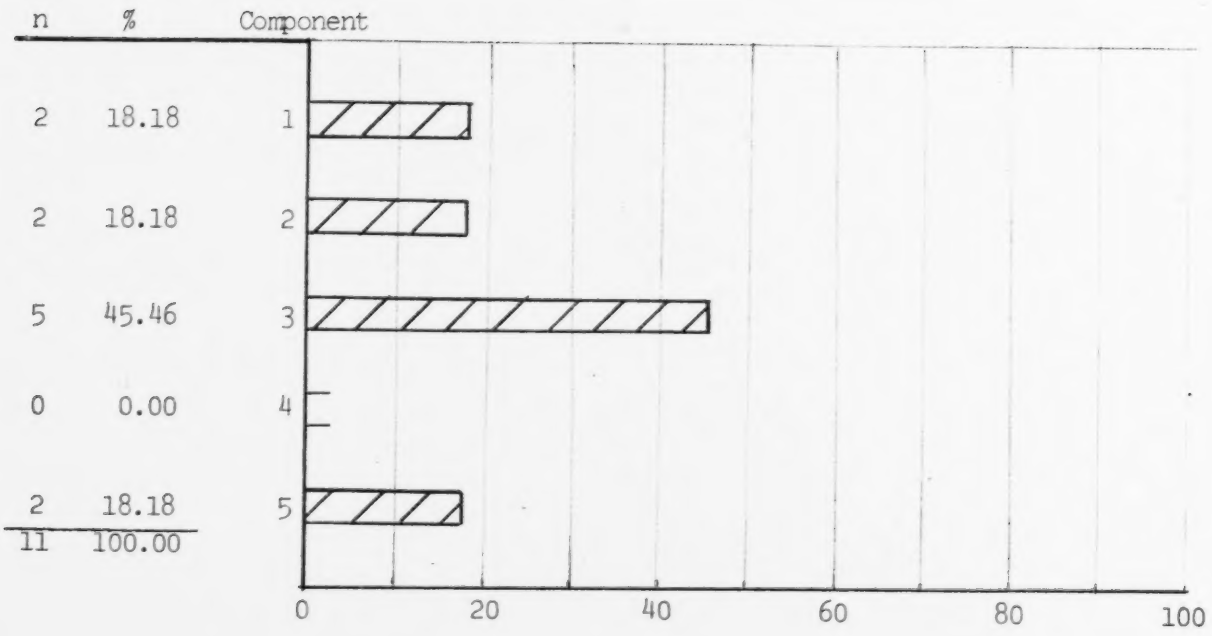
44	0	0	0.00	5	1	5.00
45	32	2	16.00	414	4	103.50
46	11	2	5.50	803	2	401.50
47	37	5	7.40	480	6	80.00
48	14	3	4.66	249	4	62.25
49	2	2	1.00	70	3	23.33
50	52	6	8.66	830	6	138.33
51	0	0	0.00	3	2	1.50
52	434	8	54.25	2460	8	307.50
53	1801	2	900.50	21810	3	7270.00
54	1	1	1.00	8	1	8.00
55	4863	9	540.33	57215	10	5721.50
56	161	3	53.66	530	4	132.50
57	14	4	3.50	250	5	50.00
58	9	3	3.00	180	4	45.00
59	2	2	1.00	46	3	15.33
60	19	1	19.00	327	3	109.00
61	6	2	3.00	160	4	40.00
62	132	5	26.40	1629	8	203.62
63	14	3	4.66	103	4	25.75
64	2	1	2.00	40	2	20.00
65	44	6	7.33	372	7	53.14
66	71	7	10.14	838	7	119.28
67	163	6	27.16	1865	8	232.12
68	161	5	32.20	2472	7	353.14
69	31	4	7.75	1310	3	436.66
70	2	2	1.00	90	3	30.00
71	5	1	5.00	106	3	35.33
72	2	1	2.00	10	1	10.00
73	4	2	2.00	75	2	37.50
74	30	1	30.00	666	4	166.50
75	2	2	1.00	40	4	10.00
76	37	3	12.33	575	5	115.00
77	9	3	3.00	262	3	87.33
78	27	4	6.75	245	4	61.25
79	4	3	1.33	56	4	14.00
80	1	1	1.00	21	3	7.00
81	34	3	11.33	710	5	142.00
82	5155	6	859.16	62010	7	8858.57
83	30	3	10.00	360	5	72.00
84	0	0	0.00	0	0	0.00
85	20	1	20.00	550	2	275.00
86	0	0	0.00	14	2	7.00
87	5	1	5.00	60	1	60.00
88	59	5	11.80	447	6	74.50
89	12	5	2.40	123	7	17.57
90	12	2	6.00	115	3	38.33
91	23	4	5.75	324	5	64.80
92	3	2	1.50	20	4	5.00
93	0	0	0.00	0	0	0.00

TABLE 6 (Cont'd.)

94	0	0	0.00	4	1	4.00
95	0	0	0.00	15	1	15.00
96	19	3	6.33	1300	3	433.33
97	0	0	0.00	25	1	25.00
98	0	0	0.00	2	1	2.00
99	0	0	0.00	2	1	2.00
100	2	2	1.00	9	3	3.00

Interpretation -- The following components were judged to have a high frequency of occurrence:

(06) perform liaison between engineering and production;
(07) conduct time and motion studies;
(11) arrange the transportation of raw materials or finished products;
(22) complete route sheets;
(24) apply basic AC or DC electrical theory;
(27) utilize waiting line or queuing models;
(28) interpret industrial sketches or prints;
(32) determine job standards;
(35) determine production costs;
(36) specify machine tool utilization;
(38) utilize electronic measuring devices;
(45) perform personnel rating;
(52) perform process trouble shooting;
(53) set work standards;
(55) perform arithmetic calculations;
(56) appraise safety performance;
(60) establish work flow;
(62) estimate labor costs;
(66) interpret geometric and positional tolerancing;
(67) utilize mechanical measuring devices;
(68) select manufacturing tools;
(74) rate worker performance;
(76) monitor for safe working conditions;
(81) standardize work methods;
(82) operate a calculator;
(83) perform trigonometric calculations;
(85) supervise welding operations; and
(88) design manufacturing tools.



PERCENT OF FIRST RANKS FOR COMPONENTS
ONE THROUGH FIVE FOR GROUP I

FIGURE 6

Interpretation -- The factor marked most consistently as the first choice for this group was #3 (utilize data processing systems).

Selected Activities with High Response by Presently Employed Workers

The following activities were judged to be critical in that employees believed them to be necessary for job success. They were judged to represent those activities requiring considerable to complete experience, greatest frequency of occurrence on the job, and were critical for the technician to progress in his work. In decreasing order of importance they are:

Highest Group	(06)	perform liaison between engineering and production;
	(28)	interpret industrial sketches and prints;
	(82)	operate a calculator;
Next Highest Group	(25)	supervise workers;
	(52)	perform process trouble shooting;
	(55)	perform arithmetic calculations;
	(91)	plan work assignments;

Next Highest Group	(22)	complete route sheets;
	(32)	determine job standards;
	(35)	determine production costs;
	(36)	specify machine tool utilization;
	(47)	analyze production costs;
	(60)	establish work flow;
	(62)	estimate labor costs;
	(74)	rate worker performance;
	(81)	standardize work methods;
	(88)	design manufacturing tools;

Next Highest Group	(16)	give oral presentations;
	(24)	apply basic AC or DC electrical theory;
	(33)	plan the flow of work;
	(38)	utilize electronic measuring devices;
	(45)	perform personnel rating;
	(65)	develop written reports;
	(66)	interpret geometric and positional tolerancing;
	(68)	select manufacturing tools;

Next Highest Group	(03)	utilize data processing systems;
	(05)	develop management control systems;
	(07)	conduct time and motion studies;
	(12)	train production workers;
	(20)	balance production line work stations;
	(53)	set work standards;
	(59)	write training material;
	(67)	utilize mechanical measuring devices;
	(70)	estimate set-up times;
	(76)	monitor for safe working conditions;
	(83)	perform trigonometric calculations;
	(97)	estimate production rates of departments;

Next Highest Group	(08)	prepare layouts of machinery or equipment;
	(11)	arrange the transportation of raw materials or finished products;
	(13)	determine material specifications;
	(14)	develop financial planning and cost analysis;
	(15)	apply operations research techniques to production problems;
	(18)	develop material handling techniques;
	(23)	forecast work loads;
	(27)	utilize waiting line or queuing models;
	(30)	design floor layouts;
	(31)	serve as a company sales representative;
	(43)	write data processing programs;
	(50)	perform algebraic calculations;
	(56)	appraise safety performance;
	(73)	complete inspection forms and records;
	(77)	interpret nomographs;
	(78)	perform statistical calculations;
	(85)	supervise welding operations; and
	(96)	supervise metal forming operations

Summary of the Methods Used in Identifying and Comparing the Tasks for the Occupational Role of Industrial Production Technologist

During the period the project developer was involved in the design of the data gathering instrument, collecting the data, and developing models, a generalizable developmental process began to evolve. The steps in the process are summarized as follows:

1. The occupational role for which training is to be provided should be defined in specific detail.
2. Local industrial job descriptions should serve as the basis for the development of a task inventory. At this time the target population of selected workers should be demographically defined by occupational level and by industry.
3. The task inventory instrument should be developed utilizing those tasks performed by the total target population. The instrument should provide for responses that indicate the frequency of occurance of an activity during the past month and during the past year. The individual worker should also be permitted to indicate his opinion as to the degree of need for knowledge or experience for an activity in respect to his job. He should also be permitted to express his opinion as to which activities are important in respect to his ability to progress in his work.
4. The task inventory instrument must be presented to supervisory and management personnel for review and criticism. At this time inappropriate tasks must be eliminated and tasks not identified by the researcher must be added.
5. The task inventory should be utilized with employees defined as being members of the target population. An attempt should be made to enlist an exhaustive number of employees from each job level and each respective industry.
6. The data gathered from the employee responses should be statistically analyzed and presented for use by instructional staff and advisory committees in further planning, development and evaluation of programs of instruction.

Suggested Additional Planning Activities

In order to provide for an understanding of the planned continuity and articulation between the results of this project and additional development activity, the following outline is provided. The general areas of concern should be:

1. Development of program philosophy, rationale, and general objectives based on industrial needs, school philosophy, and student needs;
2. Development of general program outline based on the program philosophy and rationale;
3. Development of terminal behavioral objectives based on data gathered during this project;
4. Development of general evaluation structure;
5. Development of formative evaluation system and the instruments to be used in relation to the terminal behavioral objectives;
6. Development of summative evaluation system and the instruments to be used;

7. Development of program activities for inclusion in an instructor's handbook;
8. Identify the required instructional staff specifications;
9. Identify the required instruction facilities and equipment;
10. Determination of the required administrative structure; and
11. Determination of the required guidance activities and materials.

In order to determine the ultimate effectiveness and efficiency of the program a valid total evaluation system should be designed taking into consideration items four, five and six of the about outline. The evaluation design will emphasize employee performance in respect to:

1. Employee satisfaction in respect to the work environment and the education program; and
2. Employer satisfaction in respect to worker performance on the job.

The project developer has developed a number of graphic models which illustrate the integration of the findings of this project with an idealistic educational enabling system. The considerations outlined above are also incorporated into the models. It is hoped that this report and the models provided will serve as stimuli to instructional personnel and the administration of community colleges for the improvement of vocational-technical curriculums.

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APPENDIX A

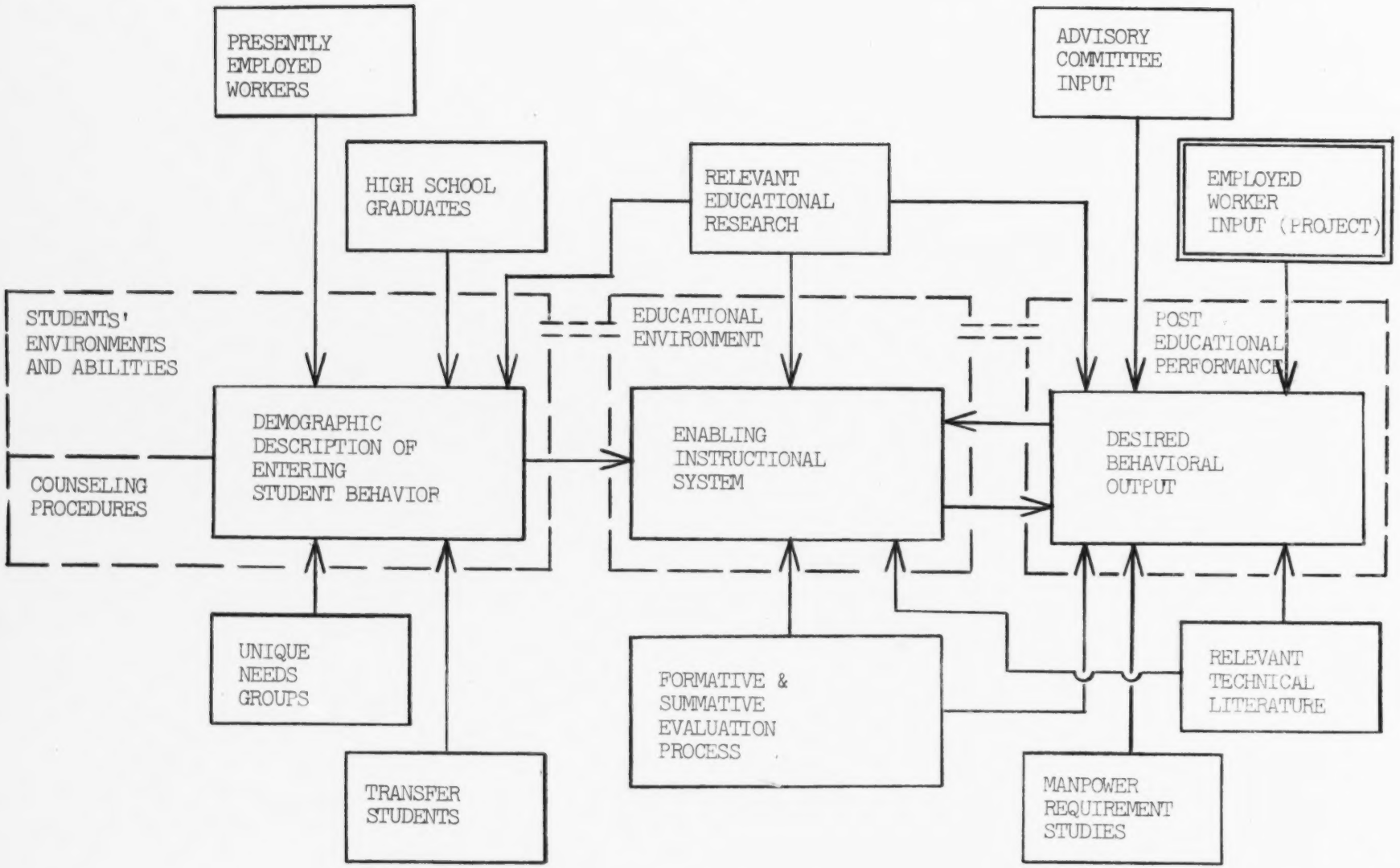

FIGURE 7
EDUCATIONAL CHANGE MODEL

APPENDIX B

QUESTIONNAIRE SCHEDULE
Industrial Production Activity Inventory
Lincoln Land Community College

General Information: 1. Name of firm or company_____

2. Position or title of individual completing questionnaire_____

Directions: The following is a list of activity items related to training needs and requirements for Industrial Production Technicians. For each statement (item) decide which one of the following ratings (1 2 3 4 5) best evaluates your feeling about the necessity for the activity item with regard to your job. The following key should be used in completing the questionnaire:

1. My job requires no knowledge or experience with this activity.
2. My job requires some knowledge or experience with this activity.
3. My job requires a reasonable amount of knowledge or experience with this activity.
4. My job requires a thorough knowledge and considerable experience with this activity.
5. My job requires a complete knowledge or experience with this activity so that it is essential to the job.

PLEASE CIRCLE THE NUMBER WHICH BEST INDICATES YOUR ANSWER FOR EACH STATEMENT. You should have encircled one number for each item when you are finished. You should also indicate the approximate number of times you performed the activity during the past month and year in the appropriate columns. In addition, the attached questionnaire should be completed using a rank order marking system for each of the general groups of the form. Please make sure you mark every blank the the category. This means that you have five ranks (1 through 5) for each category. Rank the items in terms of priority of need for the technician to have knowledge of in order to solve technical problems and to progress in his work. A one (1) indicates the greates need and a five (5) indicates the least need. Be sure to use all the ranks (1 through 5).

(EXAMPLE)

Rank	1. Activity-The ability to:	Score: No Experience				Complete Experience	Number Times Performed In Past Month	Number Times Performed In Past Year
(2)	1. Formulate written job specifications	1	2	3	4	(5)	(7)	(90)
(1)	2. Estimate job time	1	2	3	4	(5)	(20)	(300)
(3)	3. Check a drawing	1	2	(3)	4	5	(1)	(15)
(5)	4. Make an inked tracing	(1)	2	3	4	5	(0)	(0)
(4)	5. Make an assembly drawing	(1)	2	3	4	5	(0)	(0)